Studies in Hawaiian Rutaceae, II
Identity of *Pelea sandwicensis*

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THE HAWAIIAN RUTACEAE, comprising the three indigenous genera *Pelea, Platydesma,* and *Fagara,* include some 70 or 80 species all of which are trees or shrubs. Individuals of various species of *Pelea,* in particular, constitute an important element in much of the Hawaiian vegetation. The genus *Pelea* (commemorating Pele, goddess of Hawaiian volcanoes) was established by Asa Gray, who described several species. Gray's student Horace Mann botanized in the Hawaiian Islands with William Brigham, collected on several islands, and published several important works on the taxonomy of Hawaiian plants. One of Mann's special interests was the Hawaiian Rutaceae, and in a revision of these plants (in 1866) he described several new species and established the endemic genus *Platydesma.* Later, in his incomplete *Flora of the Hawaiian Islands,* Mann presented a detailed treatment of *Pelea.* It is from the original description of *Pelea sandwicensis* according to Gray, and from Mann's writings, that a long-held misconception of the identity of this perplexing species stemmed.

The species which originally was named *Pelea sandwicensis* has been misinterpreted for about a century. During the period 1832–1944 several other species of *Pelea* have passed under the name *Pelea sandwicensis,* in default of their nomenclatorially correct names. The purpose of the present discussion is to trace the confusing history of the name *Pelea sandwicensis,* to identify the various other species to which this name has been applied, and to bring into order the nomenclature and taxonomy of all these taxa.

For the sake of clarity, there follows a concise summary of the appropriate synonymy, and a newly prepared description of the holotype of *Pelea sandwicensis,* which was kindly loaned to me by the Royal Gardens, Kew.

I wish to thank the curators of the herbaria listed below for their aid. Thanks are due also to Harold St. John, whose long-standing interest in *Pelea* inspired the monographic work now in progress, and to Otto Degener, whose numerous collections were placed at my disposal.

Herbaria are indicated by the following abbreviations: BISH (Bishop Museum, Honolulu), BM (British Museum, Natural History), GOTH (Botanic Garden, Gothenburg, Sweden), CORN (Cornell University Herbarium), GH (Gray Herbarium), EDINB (Royal Botanic Gardens, Edinburgh), K (Kew), US (U. S. National Herbarium).

Pelea A. GRAY SECT. *Apocarpa* B. C. STONE in Deg. Fl. Haw. fam. 179. 1961

Pelea sandwicensis (Hook. f. & Arn.) A. Gray in Bot. U. S. Explor. Exped. 15(1): 345. 1854 (Excluding specimens cited)

Fig. 1.

Brunellia sandwicensis W. J. Hooker & Walker-Arnott in Bot. Capt. Beechey's Voy. 80. 1832.

Trees (to 8 ft high, according to Degener), with innovations, petioles, young branchlets, and dorsal leaf surfaces puberulent with minute closely appressed to slightly spreading olivaceous or buff simple trichomes 0.05–0.15 (rarely to 0.2) mm long, those of the leaves and innovations closely appressed, those of the branchlets somewhat spreading. Branchlets subterete, slightly compressed at the nodes. Leaves opposite, petiolate, the petioles 0.7–1.5 cm long, puberulent on all sides; blades oblong-elliptic, 3–8.5 cm long, 2–4.5 cm broad, entire, rounded or emarginate at apex, rounded or subtruncate at base, the costa sulcate ventrally along almost its entire length, dorsally raised and rounded; lateral nerves 6 to 10 on each side of the costa,

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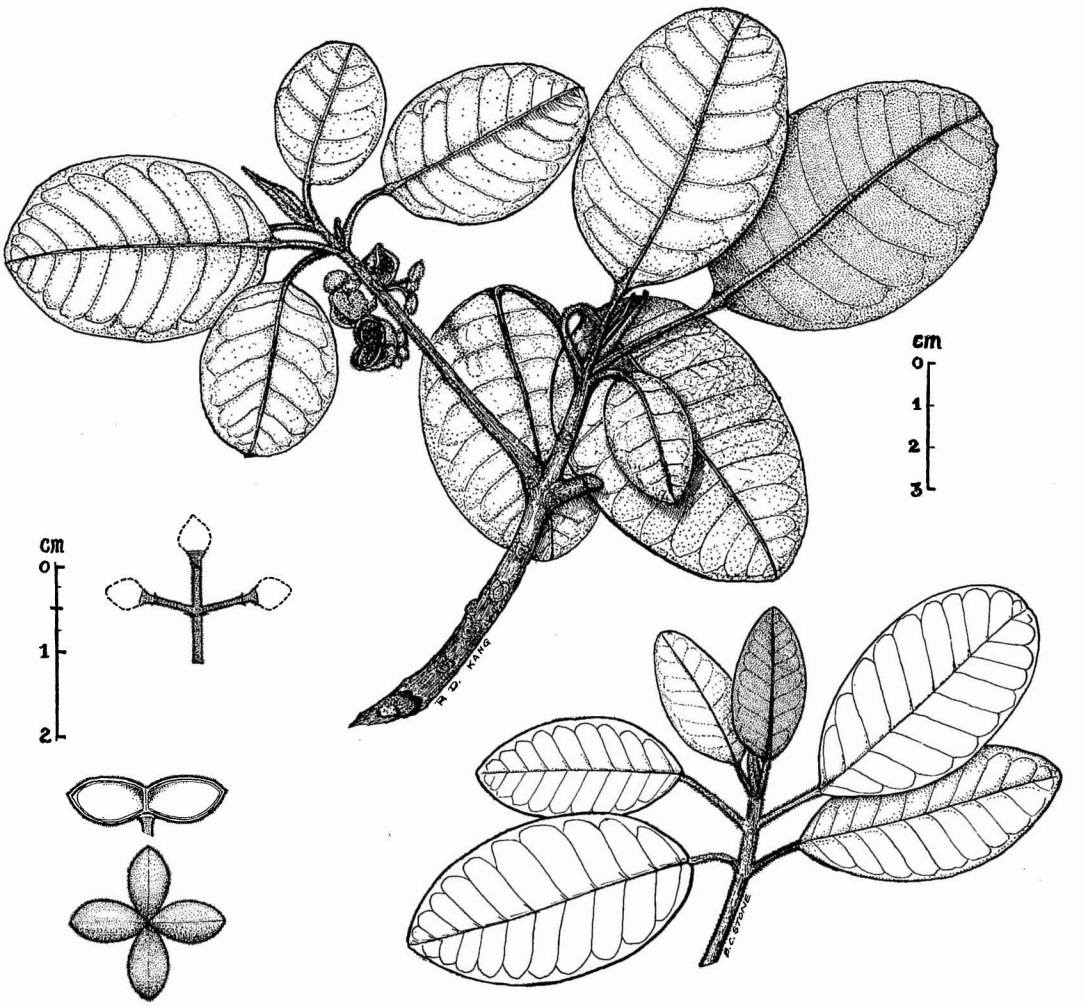

FIG. 1. *Pelea sandwicensis* (Hook. f. & Arn.) A. Gray. *1,* Habit (from holotype); *2,* cyme; *3,* capsule in top view and cross-section (from holotype; diagrammatic); *4,* habit (from *Degener 8575*).

slightly raised both ventrally and dorsally, ascending subparallel and distally upcurved, united near the margin by a slightly sinuate-arcuate nerve; minor venation slightly raised dorsally. Inflorescence axillary, cymose, 3-flowered, the peduncle ca. 6 mm long, the pedicels ca. 5–7 mm long, all minutely and closely puberulent. Flowers unknown. Fruit capsular, apocarpous, of four discrete follicles, dry, dehiscing along the upper and the distal end of the lower sutures, externally puberulent with pale erect trichomes ca. 0.1 mm long (very densely crowded on juvenile fruit), very slightly glabrate in age; endocarp smooth, glabrous, semitranslucent, glossy, yellowish brown; seeds two per follicle, irregularly ovoid (one or more flattened surfaces present), with thin glossy crustaceous black testa; capsule about 20 mm in diameter over-all.

HOLOTYPE: Oahu; Without definite locality; collected by Mssrs. Lay and Collie, on Capt. Beechey's voyage (H.M.S. "Blossom"), in May or Feb, 1826 (K).

SPECIMEN EXAMINED: Molokai; Kahua'awi gulch, near field of pigeon-peas, in moderately dry area, 12 May 1928, *O. Degener 8575* (BISH, NY).

Examination of many hundreds of herbarium sheets and of hundreds of undistributed collections, and considerable time spent in personal exploration on various Hawaiian Islands, has failed to reveal another collection or individual of this species. Thus little can be said of the natural distribution of the species. However, with a certain amount of extrapolation, based on the known distributions of other Hawaiian species, I would suggest that *Pelea sandwicensis* was characteristic of dry lowland forests on Oahu, Molokai, and possibly on Maui. Such forests on Oahu have long since been seriously disturbed and often eradicated by the inroads of civilization, and those on Molokai scarcely less so. Introduced plants (whether weeds or crops), the grazing of stock, and the growth of metropolitan and suburban Honolulu and other towns all have been inimical to the survival of the lowland forest. Since well over a century elapsed between the original discovery of the species, and its subsequent rediscovery by Degener in 1928, it would seem plausible that the species has succumbed to the disturbances mentioned. There is yet the possibility, however, that the species persists on Molokai. Much of the low-level area of Molokai has been planted with pineapple or other crops; and recent plans have been suggested for the planting of quick-growing species of *Pinus* to be used for pulp and boxwood. Such activity will almost certainly be inimical to the survival of this very rare species, and if not yet extinct, it will probably soon go the way of such species as *Kokia Cookei* (*"Gossypium drynarioides"*)[2] and other members of the peculiar lowland forests of the Hawaiian Islands which are of great scientific interest.

Nomenclatorial History of Pelea sandwicensis

Although not valid under our present nomenclatural rules, the name *brunelia sandwicensis* (sic) must be mentioned because of its role in the history of this species of *Pelea.* The name first appeared in a commentary on Hawaiian vegetation by Gaudichaud (in Voy. Uranie et Physicienne . . . Capt. Freycinet. Bot. 93. 1826) as a *nomen nudum.* Since Gaudichaud never provided a description (or illustration) of this plant, the name is not validly published. However, it seems probable that the validly published *Brunellia sandwicensis* Hook. f. & Arn. was meant to be a validation of Gaudichaud's species. Gaudichaud had collected a specimen (as will be seen further on, almost certainly on the island of Hawaii) which is extant and labelled in his script. It is not known whether Hooker and Arnott saw the specimen, which is now preserved at Paris (and a fragment also at Geneva). At any rate, they based their brief description on a specimen collected by the naturalists of the HMS "Blossom," Lay and Collie, which is labelled "Oahu." This collection represents a species distinct from that represented by the Gaudichaud specimen; and of course the Lay and Collie specimen is thus the holotype of *Pelea sandwicensis* (Hook. f. & Arn.) A. Gray.

The species represented by Gaudichaud's collection is relatively well known, and was (at last) named *Pelea Gaudichaudii* St. John in 1944. It is a close relative of *Pelea hawaiensis* Wawra, thus also a member of Section *Apocarpa.*

It is with the establishment of the genus *Pelea* by Gray that the years of confusion truly begin, however. The naturalists of the U. S. Exploring Expedition had collected several species of *Pelea* in the Hawaiian Islands which allowed Gray to distinguish the genus as new. However, Gray placed the apocarpous species of *Pelea* (i.e., species of Section *Apocarpa*) in the genus *Melicope* Forst., an unnatural position later corrected by Hillebrand. Gray did not see the Lay and Collie specimen; if he had he would have placed it in *Melicope.* He selected some U.S.E.E. specimens and, most importantly, a specimen from Oahu collected by Macrae (at Kew), to represent his concept of *Pelea sandwicensis.* It is this concept—*Pelea sandwicensis* sensu Gray—which until recently has passed as the original of this name. This concept, based on specimens representing a valid species endemic in Oahu, was finally named *Pelea honoluluensis* St. John in 1944. It is a member of Section *Megacarpa.*

Hillebrand, author of the classic *Flora of the Hawaiian Islands,* introduced still another species which he considered to be *Pelea sandwicen-*

[2] A few trees of this *Kokia* are said to exist in cultivation. Rock (Hawaii Bd. Agr. For. Bull. 6: 11, 1919) has vividly described the melancholy aspect of the last decadent members of this highly interesting species which once inhabited the arid western end of Molokai.

sis. He attempted to follow Gray, but apparently did not consult either the Macrae or the Lay and Collie specimens. That Hillebrand was aware, however, of an inconsistency is shown by his description which states explicitly that the puberulent endocarp, mentioned by Gray, was not a feature of his own specimens. The species which Hillebrand characterized under the name *Pelea sandwicensis* was named *Pelea Wawraeana* Rock in 1913. None of the several varieties which Hillebrand appends to the species is referable to it, but constitute two or three distinct species (discussed below).

The complex relationships of these species and their names may be elucidated as follows.

Descriptions of the Taxa Involved

Although the species mentioned which have become confused with *Pelea sandwicensis* are for the most part clearly distinct, and are grouped in different sections of the genus, it seems necessary to add brief descriptions of them.

1. *Pelea sandwicensis* (Hook. f. & Arn.) A. Gray. (Sect. *Apocarpa.*)

Brunellia sandwicensis Hook. f. & Arn.
Not *brunelia sandwicensis* Gaud. nom. nud.

TYPE: Oahu; Lay and Collie (K).

This is the original and long neglected *Pelea sandwicensis,* as described above. The fact that Gray erred in describing the species does not invalidate the purely mechanical nomenclatorial action of transferring the specific epithet coined by Hooker and Arnott to the genus *Pelea.* Nor does Gray's earlier mention of the name (in Proc. Amer. Acad. Arts Sci. 3: 5. 1853, repr.) matter, since the publication mentioned only "Gaud. Bot. Freyc." as the reference, and, as mentioned, his use of the name *brunelia sandwicensis* does not constitute a valid publication.

2. ***Pelea hawaiensis*** Wawra var. ***Gaudichaudii*** (St. John) B. C. Stone, comb. and stat. nov. (Sect. *Apocarpa.*)

Fig. 2.

Pelea Gaudichaudii St. John in Lloydia 7: 272. 1944.
brunelia sandwicensis Gaud. nom. nud. in Bot. Freyc. Voy. 1826.

TYPE: Hawaii; Gaudichaud (PARIS; GENEVA).

A tree with opposite leaves, the petioles 7–15 mm long, appressed-hirsutulous with pale tawny trichomes, the blades 2.5–5.1 cm long and 1.4–2.5 cm broad, subcoriaceous, ovate, dorsally somewhat reticulate, the minor venation prominulent, the costa sparsely appressed-hirsutulous, the laminar surface glabrate, ventrally at last glabrous; marginal nerve remote from the edge, sinuous-arcuate. Flowers borne in a compound cymose 15–25-flowered dichasium, the axes and minute lanceolate bracts densely puberulent. Calyx and corolla externally finely appressed-puberulent. Ovary and style puberulent, the style with spreading trichomes; stigma rotate, 4-lobed, the lobes minutely papillose, reddish; stamens (in pistillate flowers) rudimentary. Capsules mostly 16–22 mm in diameter, the carpels discrete, follicular, externally densely tawny-hirsutulous, the exocarp firm; endocarp pale, villous, thin cartilaginous; seeds 3–4 mm long, ovoid, the thin papery testa glossy black, the putamen minutely warty.

HOLOTYPE: 'Sandwich Islands' (Hawaii), Gaudichaud (PARIS). Duplicate fragment at Geneva.

SPECIMENS EXAMINED: Hawaii: Hawaii National Park, Kilauea, Kipuka Puaulu ("Bird Park"), *L. H. McDaniels 212* (BISH); *Fagerlund & Mitchell 573* (BISH, HAWAII NAT. PARK HERB.); *Cranwell, Selling & Skottsberg H.B.S. 3257* (GOTH).

The type specimen was mentioned by Adrien de Jussieu in 1825 (Mém. Rutacées, p. 119):

Obs.—Species 6 ex America australi; inter tropicos. Praeteria quaedam ex Insulis Sandwich et Rawak inedita (a Gaudichaud communicata) genere aut confunditus aut certe proxime accedit, fructibus et seminibus suppetentibus, floribus ignotis . . . endocarpium . . . in species Sandwichiana intus pube molli vestitum.

This is the earliest mention of the pubescent endocarp found in many species of the genus.

St. John quite correctly segregated the Gaudichaud specimen as a distinct taxon; however, in its significant features it corresponds so closely to *Pelea hawaiensis* Wawra (in Flora 56: 110. 1873) that I believe it is best regarded as one of several clear-cut varieties of that species. From the typical variety of *Pelea hawaiensis,*

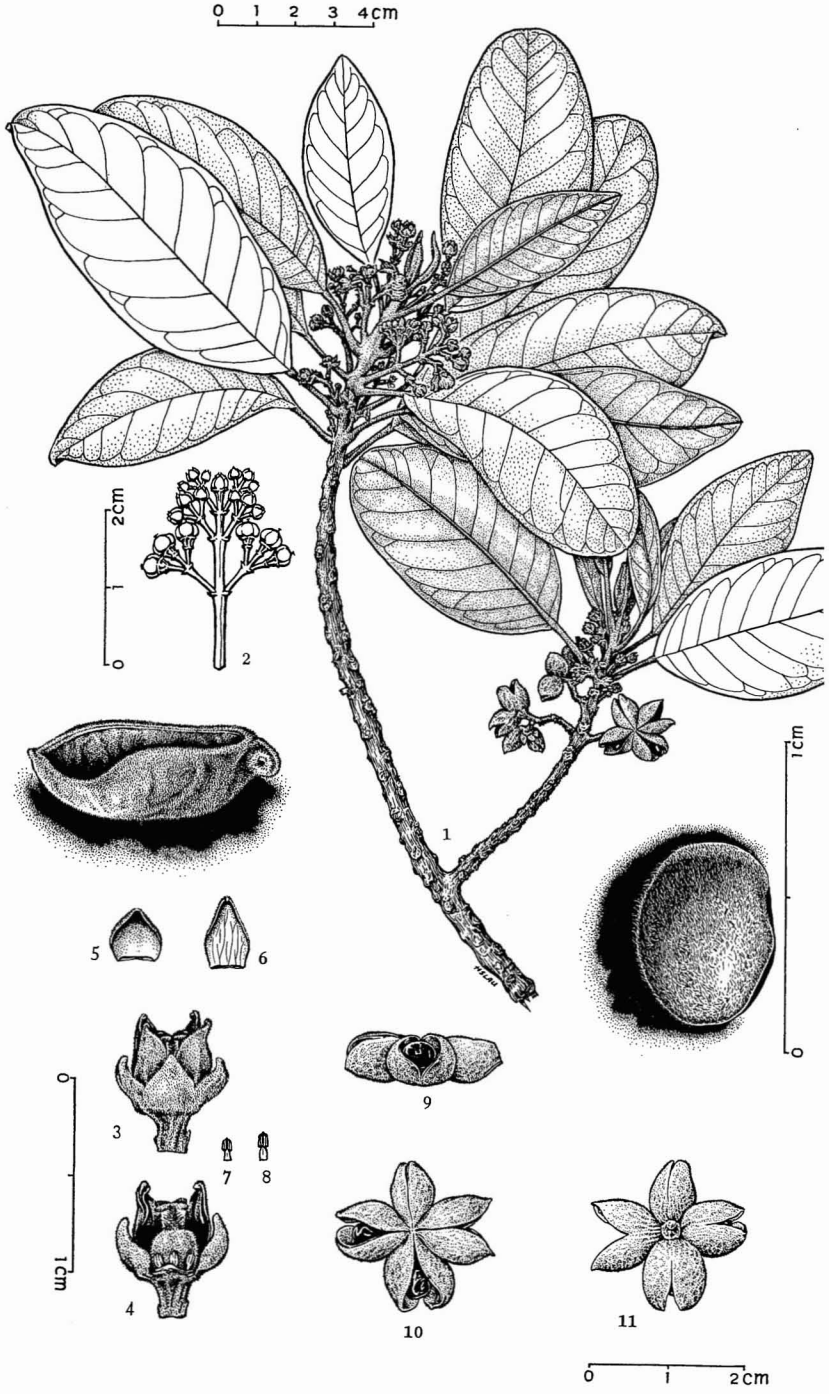

FIG. 2. *Pelea hawaiensis* Wawra var. *Gaudichaudii* (St. John) B. C. Stone. *1,* Habit; *2,* cyme (pubescence not drawn); *3–8,* pistillate flower; *9–13,* capsule: *9,* in side view; *10,* in top view; *11,* from beneath; *12,* a single follicle; *13,* endocarp. All from *L. H. McDaniels 212* (Kipuka Puaulu, Hawaii).

the var. *Gaudichaudii* differs only in the conspicuously smaller capsules, the perhaps more multiflorous cymes, and the somewhat glabrate leaves. From *Pelea sandwicensis,* it differs in the more ample compound dichasia, more ovate leaves, capsules with a much denser pubescence, and the villous rather than glabrous endocarp.

3. *Pelea honoluluensis* St. John in Lloydia 7: 268. 1944. (Sect. *Megacarpa.*)

P. sandwicensis sensu A. Gray in Bot. U. S. Explor. Exped. 15(1): 345. 1854; Atlas, pl. 37.B. 1856; sensu H. Mann in Proc. Boston Soc. Nat. Hist. 10: 315. 1866; Proc. Essex Inst. 5: 167. 1868; Rock in Indig. Trees Haw. Is. 224. pl. 85. 1913.

TYPE: Oahu; *Rock 10215* (BISH).

This species is well described and illustrated in the sources listed. It is restricted to Oahu, where it may be found chiefly in the Koolau Mountains, in wet forests generally between 2,000 and 3,000 ft elevation. It may be recognized by the following characters: rather large broad leaves, pubescent beneath on the costa; tomentose new leaves; finely puberulent small 4-lobed capsules about 20–24 mm in diameter; distinctly pubescent endocarp. Several very similar species have been described, some of doubtful validity; the following key is an attempt to elucidate their differences.

Other species similar to those keyed above are known from other islands which do not occur on Oahu. Some of these also are of dubious status. A detailed consideration of them will be presented in the monograph in progress.

4(a). *Pelea Wawraeana* Rock, Indig. Trees Haw. Is. 231. 1913. (Sect. *Megacarpa.*)

P. sandwicensis sensu Hillebrand (as to alpha var. only) in Fl. Haw. Is. 66. 1888.

TYPE: Oahu; *Rock 10220* (GH).

This species is described by Rock as new, but it is quite probable that one of the many species so carelessly described by Léveillé two years earlier (in Fedde, Rep. Sp. Nov.) is in fact the same. It is unmistakably a member of Section *Megacarpa,* endemic to Oahu.

KEY TO OAHU SPECIES OF *Pelea* SECT. *Megacarpa,* GROUP OF *P. honoluluensis*

1. Leaves glabrous.
   2. Inflorescence 7–15-flowered; endocarp at least slightly puberulent.
      3. Capsule glabrous; endocarp minutely sparsely puberulent near the sutures; capsule 11–17 mm diam. ..... *P. waipioensis* St. John
      3. Capsule puberulent; endocarp finely puberulent throughout; capsule 25–32 mm diam. ..... *P. Christophersenii* St. John
   2. Inflorescence 1–5-flowered; endocarp glabrous; capsule glabrous, 13–17 mm diam. ..... *P. descendens* St. John
1. Leaves pubescent at least on the costa dorsally.
   4. Capsule 30–38 mm diam.
      5. Capsule deeply parted (¾); cyme 3–5-flowered; capsule and endocarp pubescent ..... *P. kauaensis* St. John
      5. Capsule moderately (½–⅔) parted; cyme 9–20-flowered; capsule and endocarp pubescent ..... *P. kaalaensis* St. John
   4. Capsule 9–28 mm diam.
      6. Capsule villous throughout externally ..... *P. Storeyana* St. J. & Hume
      6. Capsule finely puberulent or somewhat glabrate.
         7. Capsule 9–18 mm diam.; innovations cinereous-puberulent; endocarp velutinous ..... *P. Hosakae* St. John
         7. Capsule 20–28 mm diam.; innovations tawny-tomentose; endocarp densely pilosulous ..... *P. honoluluensis* St. John

Hillebrand united as mostly unnamed varieties under his concept of *Pelea sandwicensis* two or possibly three distinct species.

4(b). ***Pelea Wawraeana*** var. ***ternifolia*** var. nov.

P. sandwicensis γ var. Hillebrand, op. cit. 67. ("leaves 3 in a whorl, otherwise as in β. Oahu: Halemano"); Rock in Bot. Gaz. 65: 265. 1918.

P. Wawraeana var. *tenuifolia* (Hbd. ex Rock) St. John & Hume in Lloydia 7: 273. 1944. (Nom. illegit.)

TYPE: Oahu; Hillebrand (BERLIN; now destroyed).

In taking up the varietal epithet *tenuifolia,* St. John and Hume relied on Rock's mention of this name in 1918. However, Rock had no intention of validating the name, and stated merely: "In the HILLEBRAND collection this var. β of *Pelea sandwicensis* is marked as var. *macrocarpa* Hbd., and his var. γ of the same species var. *tenuifolia* Hbd."

On page 266, Rock states:

HILLEBRAND'S var. γ *tenuifolia* of *P. sandwicensis* has also a cuboid capsule, but leaves are three in a whorl. . . . He says: "otherwise the same as β." This is not so, for *P. sandwicensis macrocarpa* has larger capsules and the carpels are divided to the middle.

Rock was correct here taxonomically; but this passing mention of varietal names from Hillebrand's manuscript is not a formal nomenclatural action. In any event, the name of the β var. is the only one used in ternary combination. Further, it is believed that Rock misread Hillebrand's script ("tenuifolia" instead of "ternifolia"). The chief character singled out by Hillebrand is the fact that the leaves are 3 in a whorl. This immediately brings to mind the epithet *ternifolia,* which I have applied here. There is some doubt however that this variety is really a form of *Pelea Wawraeana.* The locality suggests that perhaps it is not distinct from *Pelea semiternata* St. John.

5. *Pelea peduncularis* Léveillé in Fedde, Rep. Sp. Nov. 10: 443. 1912. (Sect. *Megacarpa.*)

P. sandwicensis sensu Hillebrand β var. Hillebrand in Fl. Haw. Is. 66. 1888.

P. sandwicensis macrocarpa Hbd. ex Rock in Bot. Gaz. 65: 265. 1918.

P. Rockii St. John in Lloydia 7: 271. 1944.

TYPE: Oahu; Faurie 189 (EDINB).

Arborescent; innovations finely scurfy and somewhat sparsely cinereous-puberulent, the trichomes soon caducous; the mature branchlets and leaves glabrous or the petioles sometimes with a sparse persistent minute puberulence, later glabrate. Petioles 13–35 (–40) mm long, lenticellate in age (especially at the ends); blades coriaceous, elliptic, rounded to slightly emarginate at the apex and at the base, 3–15 (–18) cm long, 2–9 (–11) cm broad, darker green above, the margin especially near the base tightly revolute (thus the leaf appearing somewhat obovate), midrib above sulcate, beneath prominent, often reddish purple; major lateral nerves mostly about 7–10 in opposed pairs, united distally by a lightly sinuate marginal nerve only 1–5 mm from the edge. Inflorescence a pedunculate usually 5–21-flowered minutely cinereous glabrate cyme often exceeding the petiolar length of the subtending leaf, the peduncle rarely up to 4 cm long (to the first node), and with 8 nodes, commonly shorter and with 2–4 nodes, stout (1–2 mm thick in fruit), the pedicels usually short, stout, 3–4 mm long; bracts lanceolate; bractlets deltoid; both minutely ciliate and sparsely puberulent, 1–3 mm long. Female flowers with sparsely scurfy-puberulent deltoid-ovate sepals about 2 × 1.8 mm, with glabrous punctate lanceovate petals about 5 mm long, reduced sterile stamens just exceeding the glabrous 4-lobed ovary, glabrous disk, reddish filiform style ca. 2 mm long with stigmatic branches 0.5 mm long, these slightly clavate and reddish, papillose, rotate. Male flowers similar but slightly larger, the petals about 7 mm long, the gynoecium much reduced, the stamens ca. 8 mm long in two subequal quartets, the longer quartet of barely exserted stamens. Capsule glabrous, about 20 mm broad and 10 mm high, lobed halfway or less; endocarp glabrous; seeds two per lobe.

HOLOTYPE: Oahu: Koolau Mountains, Kalihi, Oct. 1909, *Faurie 189* (EDINB; duplicate at PARIS).

SPECIMENS EXAMINED: Oahu: Koolau Mountains; Konahuanui, 1000 m alt., May 1910, *Faurie 194* (PARIS). Pupukea summit trail, Feb 1960, *Pearsall 480* (BISH). No definite locality, *Rémy 621* (male, PARIS).

This species is thoroughly distinct from *Pelea sandwicensis* and from *P. honoluluensis.* It is reminiscent of *P. Wawraeana,* but in general easily distinguished. However, it is characterized by capsules which may sometimes be mistaken for those of the latter species; they are larger and not cuboid, but sometimes are nearly square in top view. The reddish flowers and rather elongate inflorescences serve to distinguish the species.

Léveillé did not mention any of Hillebrand's specimens, and his usual cryptic description, though longer than customary, is quite inadequate to distinguish the species. A study of the isotypes (*Faurie 189*) and of a considerable number of recent collections convinces me that the name must be taken up. There are a number of problematic entities and names associated with this species which may merit recognition which will be treated later. Also there is the problem of delimiting Section *Cubicarpa,* which in turn is based on the constancy of the degree of carpel separation in fruits of several species.

The revolute basal leaf margins in plants of this species provide a conspicuous but overlooked character. It is also found in specimens of *Pelea Zahlbruckneri* Rock, *P. paniculata* St. John, and sometimes in other species.

6. *Pelea lucens* (Hillebrand) St. John in Lloydia 7: 269. 1944. (Sect. *Cubicarpa?*)

P. sandwicensis δ var. *lucens* Hillebrand op. cit. 67.

TYPE: Oahu; Mt. Kaala, Hillebrand (BERLIN; the type destroyed).

LECTOTYPE: Oahu; Mann & Brigham 208 (CORN; duplicate at BISH). Cited by Hillebrand.

This tentatively accepted species appears to be a relative of *Pelea Wawraeana.*